MONTHLY WEATHER REVIEW.

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INTRODUCTION.

This REVIEW contains a general summary of the meteorological conditions which prevailed over the United States and Canada during January, 1887, based upon the reports from the regular and voluntary observers of the Signal Service and from co-operating state weather services.

Descriptions of the storms which occurred over the north Atlantic Ocean during the mouth are also given, and their approximate paths shown on chart i. In tracing the centres of the paths of these storms, data from the reports of one hundred and eighty-three vessels have been used.

The general character of the weather over the north Atlantic Ocean during the month was seasonable, although, in instances, storms of unusual severity were encountered.

The presence of an iceberg to the northeastward of the Banks of Newfoundland on the 30th indicated a seasonable breaking up of the Arctic ice fields, and large quantities of icebergs and field-ice will doubtless move southward over the Banks during February.

On chart i for this month are traced the paths of fourteen areas of low pressure; the average number for January during the past thirteen years being 13.0. The most noteworthy atmospherical disturbances of the month occurred during the prevalence of low area number viii on the 13th and 14th, producing rain, snow, and sleet with high winds on the Lakes and thunder-storms in the south Atlantic states, Florida, and the Ohio Valley. The low area which was central in the Indian Territory and northern Texas on the morning of the 22d was attended on that and the succeeding day by thunder-storms in the Gulf States and very heavy rain in Tennessee and the lower part of the Mississippi Valley, numerous stations in these districts reporting over two inches of precipitation in twenty-four hours.

The mean temperature of the month is below the normal in Dakota, Nebraska, and over the entire eastern half of the country, except along the coast of New England and the middle Atlantic states where it is about normal; the temperature of the western part of the country has been above that of the average January.

With the exception of portions of Georgia and South Carolina, the precipitation of the month is below the normal in all parts of the country lying south of the fortieth parallel; it is also deficient in northern Idaho, northern Montana, Nebraska, Iowa, and northern Michigan.

In the preparation of this REVIEW the following data, received up to Febuary 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-three Canadian stations, as telegraphed to this office; one hundred and sixty-two monthly journals; one hundred and fifty-seven monthly means from the former, and twenty-three monthly means from the latter; two hundred and eighty-six monthly registers from voluntary observers; fifty-six monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Alabama, Arkansas, Illinois, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, North Carolina, South Carolina, and Tennessee; and of the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE.

[Expressed in inches and hundredths.]

The distribution of mean pressure for January, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii.

Two areas of high pressure appear on chart ii, one covers the southwestern part of Oregon and the northern and central parts of California; within this area the mean pressure of the month varies from 30.16 at Sacramento, California, to 30.19 at Roseburg, Oregon; the second area extends over Georgia and the greater part of South Carolina, Alabama, and northern Florida; within this area the pressure of the month is 30.15 or more. The mean pressure in the south Atlantic states, east Gulf states, Florida, Louisiana, and eastern Texas is 30.10 and above. Two areas of low pressure are shown on chart ii, one extends over the northern plateau region of the Rocky Mountains and exhibits a mean barometric pressure of 29.95 or less; the other covers the state of Michigan, Lake Huron, and the northern and eastern parts of Canada; over these districts the pressure is also 29.95 or less. The highest mean pressure of the month, 30.19, occurred at Roseburg, Oregon, and the lowest, 29.81, at Fort Maginpis, Montana.

The departures from the normal pressure are given in the table of miscellaneous meteorological data, and are also shown on chart iv by lines connecting stations of equal departure. The pressure of the month is normal or slightly above in the south Atlantic states, the Gulf States, Florida, Arizona, California, and southern Oregon, in all other districts of the United States it is largely below the normal. The greatest deficiencies occur in Montana, northern Idaho, and the eastern part of Washington Territory, where the departures range from .20 to .26 below the normal. The deficiencies in the middle slope, Missouri Valley, upper Mississippi valley, and the Lake region are also large, ranging from .07 at La Crosse, Wisconsin, to .14 at several stations on the lower lakes. In the extreme eastern part of Canada the pressure of the month is normal or slightly above; in the Saint Lawrence Valley and New England it averages about .08 below, the departures varying from .05 at Eastport, Maine, to .10 at Boston, Massachusetts.

As compared with the pressure of the preceding month, December, 1886, very large deficiencies occur in all parts of the United States, except in the south Atlantic states, east Gulf states, and on the Pacific slope; in these districts the pressure for January, 1887, coincides with, or is slightly above, that of the preceding month. In the northern plateau region, Mis-

souri Valley, and upper Mississippi valley the pressure averages about .17 below that of December, 1886, and ranges from .14 below at Saint Louis, Missouri, to .23 below at Fort Maginnis, Montana. In the Lake region and the Ohio Valley the deficiencies are also large, averaging about .15

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous data. The following are some of the extreme monthly ranges:

Greatest.		Least.	
	Inch.		*Inch.*
Huron, Dakota	1.84	San Diego, California	0.39
Fort Custer, Montana	1.72	Los Angeles, California	0.44
Valentine, Nebraska	1.68	Fort Grant, Arizona	0.56
Yankton, Dakota	1.66	Key West, Florida	0.56
Mount Washington, New Hampshire	1.60	Yuma, Arizona	0.59
Alpena, Michigan	1.58	Prescott, Arizona	0.68
Mackinaw City, Michigan	1.56	Fort Apache, Arizona	0.68
La Crosse, Wisconsin	1.56	Fort Thomas, Arizona	0.68

AREAS OF HIGH PRESSURE.

Seven well-defined areas of high pressure have been traced within the limits of the United States. The general movement of these areas was in a southeasterly direction while west of the Mississippi Valley, and in a northeasterly direction while approaching the Atlantic coast from latitudes below 40°; the movement of the areas north of the Lake region being more directly to the east. Chart v exhibits the barometric changes occurring at selected stations, and shows that five decided areas of high pressure passed over the centre of the continent, attended by cold waves, on the 1st, 8th, 16th, 26th, and 30th–31st. These areas of high pressure were generally observed to the east of the Rocky Mountains and to the north of Montana and Dakota, but in some cases they were apparently reenforced by areas approaching from the Pacific. Chart v exhibits the barometer changes occurring at Portland, Oregon, during the month, it will be seen that the pressure remained high from the 1st to 11th, and that high areas passed over that station on the 16th and 24th. The most decided cold waves of the month, extending over the Southern States, attended the areas of high pressure which were observed in the Northwest on the 1st and 7th, causing the temperature to fall below freezing at New Orleans from the 1st to 4th and on the 10th and 11th. The cold waves occurring after the 8th were less marked in the temperature changes over the Southern States, the temperature not reaching the freezing point at New Orleans after the 11th. The areas of high pressure which extended over the Northwest on the 16th, 26th, and 31st were attended by cold waves which advanced more directly to the eastward, causing the low temperatures which were observed in the eastern portion of the United States on the 19th, 27th, and at the close of the month, respectively.

The following are general descriptions of the more important high areas observed during the month.

I.—The month opened with a high area, bounded by the isobar of 30.8, extending over Dakota, with temperatures ranging from —25° to —41° in eastern Dakota and Minnesota. This area extended southward to the west Gulf coast, causing freezing weather and a dry "norther" throughout Texas and the Southwest. It extended southeastward during the 2d and was central near Cairo, Illinois, on the morning of the 3d, while the cold wave attending this area had advanced to the Atlantic coast. Freezing weather occurred at stations on the Gulf coast and in northern Florida. After reaching the Mississippi Valley the movement of this high area was to the eastward over the New England and middle Atlantic states during the 4th and 5th. The winds shifted to northeasterly at stations to the south of the centre, and snow and sleet were reported from the Southern States on the morning of the 5th. The barometric pressure decreased slowly with the easterly movement of this area, the pressure being from .10 to .20 inch less at the centre at stations on the Atlantic coast than it was at stations in the upper Missouri valley when the area was central in that region. The cold wave attending this area of high pressure caused changes in temperature ranging from 20° to 30° in twenty-four hours over the regions east of the Rocky Mountain slope. The greatest change in twenty four being in Iowa, Minnesota, and on the south Atlantic coast on the 2d; and on the New England coast and thence northeastward the temperature fell from 20° to 30° on the 2d and 3d.

II.—This area appeared north of Minnesota and Dakota on the 4th and was re-enforced by an area from the Pacific coast on the 5th, causing the pressure to increase to 30.90 and above at stations north of Montana on the afternoon of the 5th, while an area of low pressure, which was immediately to the south of Colorado on the morning of the same day, had been forced southward over New Mexico and western Texas. On the morning of the 6th the high area was central in eastern Dakota, bounded by the isobar of 30.6, and attended by temperatures ranging from —20° to —40°. The rapid increase of pressure on the eastern slope of the Rocky Mountains attending the southerly movement of this area and the southerly movement of the area of low pressure (traced as number iii) immediately to the south, was apparently forced southward and disappeared under the influence of the area of high pressure. After reaching the lower Missouri valley on the afternoon of the 6th there was an increase of pressure to the northward which transferred the centre of this area to the northwestward over Dakota at midnight of the 7th, after which it moved southward to Texas and thence eastward over the Gulf States, disappearing on the 11th to the east of Florida. The barometric pressure observed near the centre of this area decreased from 30.9, when the centre was north of Montana, to 30.6 in the Missouri Valley, 30.3 in northern Texas, and 30.2 in the east Gulf states. The most marked changes in temperature observed during the transit of this cold wave occurred in the northern Rocky Mountain region on the 5th and 6th, in northern New England and the Saint Lawrence Valley on the 7th and 8th, and in Texas on the 8th; these changes ranging from 20° to 40°. This, and the preceding area, produced the coldest weather experienced during the month in the Southern States and central valleys.

III.—This area appeared north of Montana on the afternoon of the 15th, while a second area extended over the north and central Pacific coast regions. This distribution of pressure continued until the morning of the 16th, after which the two areas united, covering the entire Rocky Mountain region on the morning of the 17th, the bounding isobar of 30.6 including Colorado and the greater portions of Wyoming and Utah. It advanced slowly over the Mississippi Valley, causing a "norther" in the Southwest on the 18th, and attended by freezing weather in the Southern States, and temperatures generally below zero north of the Ohio Valley. The movement was southeasterly from the lower Missouri valley during the 18th, it then passed over the Southern States and off the Atlantic coast during the 18th and 19th, the pressure decreasing as the area moved toward the east, and the isobars extended northeastward along the Atlantic coast. The low temperatures observed in New England on the morning of the 19th, when the area was central off the south Atlantic coast, were probably due to the cold westerly winds attending this area of high pressure in its northern quadrants. On the morning of the 18th the temperature ranged from —13° to 8° at stations in the Lake region, and the isothermal line of 10° extended northeastward from the Ohio Valley to northern New England, the velocity of the westerly winds ranging from ten to twenty-five miles per hour. The wind continued westerly and the weather was generally clear on the Atlantic coast during the night of the 18th. The minimum temperatures which occurred during the transit of this area were the lowest observed during the month at many points in the Northern States.

IV.—From an examination of chart v it will be seen that an area of high pressure passed over New England on the 22d, causing the temperature to fall 20° to 40° in twenty-four hours. This high area apparently formed quickly north of the Lake

region during the 21st and moved rapidly over New England and off the Atlantic coast, causing no marked changes in temperature at stations south of New England.

V.—This area of high pressure formed on the Pacific coast on the 21st, from which region it moved southeastward over the Gulf of Mexico and thence eastward to the Atlantic, without causing any marked changes in temperature. When it approached the Southern States from the southern Rocky Mountain regions it was attended by heavy rains along the Gulf coast and as far north as Tennessee and North Carolina. These rains were probably due to the sudden fall in temperature caused by the advance of the cold air from the mountain regions, the isothermal lines of 40°, 50°, and 60° over the region of heavy rains, extended approximately north and south. The winds in this region, previous to the heavy rains, had been southerly from the 19th to 23d. The barograms on chart v for the stations Boston, Massachusetts, Saint Paul, Minnesota, and Portland, Oregon, give no marked indications of the movements of this area of high pressure as it passed to the south of these stations, and the pressure decreased during the transit from the Rocky Mountains to the Gulf of Mexico, leaving but a slight trace of its influence in the barograms for New Orleans, Louisiana.

VI.—This area appeared on the Pacific coast on the 24th and is distinctive as the only high area which passed from the Pacific to the Atlantic during the month. It extended from the northern to the southern boundaries of the United States, and its movements may be traced from the four barograms represented on chart v. It appeared at Portland, Oregon, on the 24th, at Saint Paul, Minnesota, on the 26th, New Orleans, Louisiana, on the 27th, and at Boston, Massachusetts, on the 28th, thus crossing the continent in less than four days. The barometer rose at the centre of this area as it crossed the continent and the greatest pressure was observed in Nova Scotia after its centre had passed to the eastward. The movement was slightly to the south of east from latitude 40° on the Pacific coast to northern Texas, and afterwards to the north of east from Texas to Nova Scotia. The fall in temperature was general, but the greatest change in twenty-four hours occurred on the Atlantic coast; in New England the change in twenty-four hours amounted to 35° or 40°.

VII.—The tri daily telegraphic reports of the 28th and 29th indicated the advance of this high area and attending cold wave in the extreme northwest. The pressure continued to increase near the centre of the continent during the 30th and 31st, and at the close of the month it had reached 30.70 at stations north of Dakota, with temperatures ranging from —20° to —36°. Although the centre of this high area remained far to the north at the close of the month, the cold wave attending it had extended southward over Missouri and the Ohio Valley, and eastward over the Lake region by midnight of the 30th, and over the Saint Lawrence Valley and the New England coast during the 31st.

AREAS OF LOW PRESSURE.

Fourteen areas of low pressure appeared within the limits of observation during January. They were generally first observed in the Rocky Mountain region north of Montana and Idaho, and telegraphic reports indicate that seven of the areas traced originated at least as far to the west as the north Pacific coast and to the north of the stations of observation. The direction of movement was to the southeast or south during the transit over the Rocky Mountain regions, easterly between the eastern slope of the Rocky Mountains and the Mississippi Valley, and north of east between the Mississippi Valley and the Atlantic. All low areas crossing the continent reached the coast north of the Middle States, and all passed to the north of the Ohio Valley. One storm is approximately traced as following the general course of the Gulf Stream, and a secondary depression developed on the New England coast, which moved eastward over the Atlantic.

The following table shows the latitude and longitude in which the centre of each area was first and last observed, and the average hourly movement:

Areas of low pressure.	First observed.		Last observed.		Average velocity of translation in miles per hour.
	Lat. N.	Long. W.	Lat. N.	Long. W.	
	° ′	° ′	° ′	° ′	
No. I	40 00	106 00	48 00	58 00	22.0
II	51 00	108 00	48 00	75 00	30.0
III	38 00	103 00	33 00	103 00	21.0
IV	33 00	73 00	44 00	59 00	37.0
V	50 00	117 00	33 00	107 00	24.0
VI	40 00	87 00	47 00	59 00	40.0
VII	52 00	109 00	48 00	60 00	42.0
VIII	51 00	115 00	43 00	75 00	32.0
VIIIa	41 30	71 00	43 00	62 00	23.0
IX	51 00	102 00	62 00	50 00	38.0
X	48 00	111 00	50 00	63 00	31.0
XI	49 00	123 00	45 00	65 00	36.0
XII	50 00	123 00	44 00	66 00	46.0
XIII	53 00	115 00	49 00	85 00	35.0
XIV	47 00	109 00	51 00	62 00	43.0

Average rate of movement, 37.0 miles per hour.

Although fourteen areas of low pressure have been traced, it will be seen by examining chart v that the most marked barometric changes occurred near the centre of the continent, in the vicinity of Saint Paul, Minnesota, on the 3d and 4th, from the 10th to 16th, on the 19th and 20th, on the 24th and 25th, and 28th and 29th. From the same chart it will be seen that the areas of low pressure passing over New England were more numerous.

The following are general summaries of the meteorological conditions attending the more important of these areas of low pressure while within the limits of observation:

I and II.—This storm has been previously traced from the Rocky Mountain region to the Atlantic coast during the latter part of December, 1886, and on the morning of January 1, 1887, it was central near the southern New England coast. It passed northeastward, with decreasing pressure at the centre, until the afternoon of the 2d, when the central area had become extended and was bounded by the isobar of 29.3, the stations in the Maritime Provinces being then located in the southwest quadrant of this low area. This storm was followed by a rapid rise in the barometer on the Atlantic coast, the increase of pressure in twenty-four hours ending in the afternoon of January 3d amounting to 1.00 north of New England, and more than 0.50 at stations on the Atlantic coast north of Virginia. This general increase of pressure on the coast was accompanied by a corresponding decrease (low area number ii) on the eastern slope of the Rocky Mountains, due to the advance of an area of low pressure, which followed the general course of the Missouri Valley until it reached the vicinity of Omaha, Nebraska, at midnight of the 3d, when its course changed to the northeast and it passed over the Lake region, attended by general snows in the central valleys and thence eastward to the Atlantic coast.

III.—This area has been previously referred to in the description of areas of high pressure and cold waves. The 10 p. m. weather map of the 4th exhibited a trough of low pressure extending from Colorado northwestward to Washington Territory, with a cold wave apparently crowding southward from British America. The succeeding report indicated a southerly movement of both the low and the high area, and these conditions continued during the 5th, when the pressure had increased 0.50 on the northern slope of the Rocky Mountains, and had decreased 0.40 in the upper Rio Grande valley. The increase of pressure above referred to extended over the middle and southern Rocky Mountain slopes during the 6th, completely replacing this low area. The depression thus forced south was only relatively low, the minimum pressure being but 0.10 below the normal.

IV.—This storm may have originated in the Gulf of Mexico, but it has only been approximately traced along the Atlantic coast during the 5th and 6th. It apparently reached its maximum energy when the centre was near the southern coast of New England on the morning of the 6th, when the weather

map showed a slight depression north of the lower lake region, within which the pressure was increasing. This storm moved northeastward from the New England coast, causing severe gales over the north Atlantic on the 6th and 7th.

V.—This depression originated north of Oregon on the 6th and moved southward over Idaho, Wyoming, and Colorado during the 6th and 7th. It remained almost stationary during the 8th, and on that date disappeared while central over New Mexico. As in the case of number iii, the southerly course of this storm seems to have been caused by an extended area of high pressure which moved from the British possessions southward over the eastern slope of the Rocky Mountains and Mississippi Valley. In the present case the departure from the normal in the area of low pressure exceeded 0.30, while the departures from the normal within the area of high pressure to the northward ranged from 0.50 to 0.60.

VI.—The cold wave which extended southward over Texas during the 8th and 9th was preceded by a trough of low pressure which extended northward from the Gulf to the upper lake region. The cold air from the Rocky Mountain slope moved eastward over the lower Mississippi valley, causing the pressure to increase in the South and resulting in the formation of a cyclonic area, central in the lower Ohio on the morning of the 9th. This storm moved rapidly over the lower lake region and New England during the 9th and 10th, the barometer falling from 30.00 to 28.97 at the centre of this area during its movement from northern Indiana to Sydney, Nova Scotia, where it was central at 10 p. m. of the 10th. General snows attended the movement of this disturbance at stations east of the Mississippi, and as far south as Tennessee and North Carolina, and rains and light snows were reported from the east Gulf states. The winds were moderate in the Lake region and were brisk to high on the Atlantic coast north of Cape Hatteras, after shifting to the northwest.

VII.—This depression appeared in the British possessions north of Montana during the night of the 9th and passed eastward to Lake Superior, where it was central on the 11th. It was attended by light snows in the Lake region, Saint Lawrence Valley, and northern New England, and although the barometer fell below 29.40 when the centre passed over Lake Huron no marked changes in the weather conditions were observed during its easterly movement over the Saint Lawrence Valley and the Maritime Provinces.

VIII.—This depression was observed north of Idaho at 10 p. m. of the 11th. It moved rapidly southeastward, following the course of the Missouri Valley, and including within its limits the eastern slope of the Rocky Mountains from Texas northward to Dakota. Light snows were reported in the northern quadrants on the 12th and 13th, attended by northerly winds and low temperatures, but the weather remained generally fair in the southern quadrants until the centre reached the Mississippi Valley on the morning of the 13th, when the rain-area rapidly extended over the entire area east of the Mississippi and south of the Ohio River, while the snow-area extended over the Northern States to the New England coast by the morning of the 14th. The barometer reached its minimum while the disturbance was central over Lake Erie, when the depression was contracted and elliptical in form, the longer axis being in an east and west direction, bounded by isobars of 29.5, 29.6, and 29.7. The general form of this area while passing over the eastern Rocky Mountain slope was elliptical, with the longer axis pointing in a north and south direction. The central area became more extended during the 14th, and the pressure increased at the centre, while a secondary depression developed on the New England coast which was attended by severe northerly gales. The formation of this secondary depression apparently resulted in a loss of energy and the disappearance of this storm before reaching the Atlantic coast. Its centre was last located as central in western New York.

The following notes from observers are of interest in connection with this storm:

Mackinaw City, Michigan: light snow began at 11.05 a. m. of the 13th; at 11.25 a. m. an easterly gale set in and continued during the day, attaining at 9 p. m. a velocity of forty miles per hour. After midnight the wind backed from east to northeast and continued until 11.40 of the 14th, maximum velocity thirty-eight miles per hour.

Green Bay, Wisconsin: light snow fell during the 13th, accompanied during the afternoon by an easterly gale. On the morning of the 14th the wind blew hard from the northeast, attaining a maximum velocity of thirty-six miles per hour.

Cairo, Illinois: on the 13th the barometer fell rapidly, reading at 3 p. m. 29.34, with brisk to high variable winds, maximum velocity thirty-seven miles per hour from the west. During the storm the Mobile and Ohio Railroad round house was blown down, and the boat "Joe Williams" and several barges were blown ashore at East Cairo, Kentucky.

Smithville, North Carolina: a thunder-storm, with heavy rain, occurred during the night of the 13–14th. From 8 to 9 p. m. of the 14th a southeasterly gale prevailed, maximum velocity thirty-seven miles per hour.

Boston, Massachusetts: snow and heavy rain fell at intervals throughout the 14th, accompanied by a northeasterly gale, which attained at 7 a. m. a velocity of forty-eight miles per hour.

Eastport, Maine: on the 14th light snow began falling at 7.40 a. m.; at 10 a. m. it changed to sleet, and again to light snow at 5.10 p. m. At 6.15 a. m. a northeasterly gale set in, attaining at 8.15 p. m. a velocity of fifty-five miles per hour. During the day the barometer fell rapidly. The snow and gale ended during the morning of the 15th.

IX.—The midnight report of the 14th indicated the presence of a depression north of Dakota. At the following telegraphic report the region of least pressure had shifted westward to the northern Rocky Mountain stations, from which region an extended area of low barometer moved southeastward during the 15th and 16th, reaching the vicinity of Lake Michigan at 10 p. m. of the 16th. This area of low pressure was followed by a rapid increase of pressure and a cold wave over the central valleys. From the Lake region the course of this depression was northeastward, down the Saint Lawrence Valley, attended by severe gales in the south and west quadrants. The barometer fell to 28.82 at Anticosti, Gulf of Saint Lawrence, on the morning of the 18th, when the centre of disturbance was near that station. Gales continued at the northeastern Canadian stations and along the Atlantic coast north of Hatteras on the 17th and until the morning of the 18th.

The following notes relate to this storm:

Grand Haven, Michigan: light snow began falling during the early morning of the 17th and continued without cessation throughout the day, accompanied by high northwesterly winds which blew for a time at the rate of forty miles per hour. The snow drifted badly and all trains were delayed several hours; all local traffic was suspended.

Buffalo, New York: after 3 p. m. of the 16th the barometer began falling rapidly and the wind backed to east and northeast. During the night of the 16–17th the barometer fell four-tenths of an inch, at the same time a decided rise in temperature occurred, with snow. At 5.15 a. m. of the 17th a severe southwesterly gale set in and increased in velocity until 2.50 p. m. when it had attained a velocity of fifty-eight miles per hour; the gale continued until 8.15 a. m. of the 18th. During the 18th the pressure rose rapidly, with falling temperature; minimum, —1°.7.

Mackinaw City, Michigan: the 16th opened with cloudy weather and brisk southeasterly winds, shifting to east and blowing with increased velocity. An easterly gale, average velocity twenty miles per hour, began at 10.50 a. m. and continued until 3.40 a. m. of the 17th; maximum velocity thirty-seven miles per hour. At 10 a. m. of the 17th the wind backed to northwest and blew a gale throughout the day; maximum velocity, thirty miles per hour, at 2.30 p. m. Heavy snow fell from 6 p. m. of the 16th until 2 p. m. of the 17th.

Chincoteague, Virginia; during the 17th the barometer fell rapidly, reaching 29.44 at 3 p. m., after which it rose as rapidly. In the early morning the wind was fresh from the south, becoming brisk at noon, and again fresh until 4 p. m. when it shifted to the northwest and began blowing a gale, reaching at 9 p. m. a maximum velocity of fifty-six miles per hour, and for ten minutes blowing at the rate of sixty-five miles per hour. Heavy rain, with snow at intervals, fell during the night of the 17–18th. The 18th was cold, with brisk to high northwesterly winds prevailing.

Rochester, New York: the barometer fell very rapidly during the night of the 16–17th, reading 29.34 at 7 a. m. of the 17th, with wind from the south and fresh until 10 a. m. when it shifted to west and increased in force, attaining at 11.15 a. m. a velocity of forty-six miles per hour, and at 1.15 p. m. fifty-two miles per hour. On the 18th the wind blew hard from the northwest, with falling temperature and light snow,

Key West, Florida: At 5.18 a. m. of the 18th a strong northerly gale set in and continued throughout the day, attaining at 5.30 a. m. a velocity of thirty-nine miles per hour.

Cedar Keys, Florida: on the 17th the wind blew steadily from the south until 1 p. m. when it increased in force, veering to the west at 5 p. m., and later, to the northwest. At 8.40 p. m. the wind attained the velocity of a gale;

maximum velocity, thirty-two miles per hour from the northwest, at 10.20 p. m. Light rain fell from 6.30 to 7.10 p. m.

X.—Number x was observed in northern Montana on the morning of the 19th; it passed southeastward, following the general course of the preceding storm; the southeasterly movement ended in southern Dakota and the storm passed over the upper lake region on the 22d, developing considerable energy when central near Mackinaw City, Michigan, where the barometer fell to 29.01 on the afternoon of the 20th. It moved northeastward over the Saint Lawrence Valley, causing gales at extreme northeastern stations on the 21st. The central area became greatly extended as it moved to the northeast, but the wind increased in force and the most severe gales reported during the month occurred along the Atlantic coast as this storm passed over that region.

The following notes by Signal Service observers are of interest:

Buffalo, New York: a southwesterly gale set in at 7.30 a. m. of the 20th and continued until 6 a. m. of the 21st; at 9.10 a. m. it reached a velocity of fifty-eight miles per hour. During the storm the ice on the lake was broken up for a distance of about ten miles out, which is a very unusual occurrence for this season.

Mackinaw City, Michigan: a southerly gale, shifting to the southwest, began at 1.45 a. m. of the 20th; during the afternoon the wind shifted to the west, and attained a velocity of thirty-six miles per hour at 7.45 p. m. The barometer fell rapidly until 1.30 p. m. when it stood at 28.97, after 1.30 p. m. it began rising rapidly.

Cairo, Illinois: during the 20th high variable winds prevailed, maximum velocity forty-four miles per hour from the southwest. River men state that this was the strongest wind that has occurred on the river for many years; several barges were torn from their moorings and blown across the river.

XI.—This storm appeared on the north Pacific coast on the afternoon of the 20th, and crossed the continent to the Nova Scotia coast, it being clearly defined and the centre approximately located at each of the tri-daily reports from the date of its appearance until the 10 p. m. report of the 24th, when the centre was located near Eastport, Maine. The course was southeasterly to northern Texas and thence northeastward over the Lake region and New England. The barometric pressure increased at the centre as it passed eastward from the Pacific coast to the Rocky Mountain region. When central in northern Texas three areas of high pressure were shown on the weather charts, one to the north over Manitoba, one on the north Atlantic coast, and the third on the central Pacific coast. An extended trough of low pressure separated the areas of high pressure and covered the region from the upper lake region southwestward to the Rio Grande Valley, within which this low area was enclosed, bounded by isobars of 29.5, 29.6, and 29.7, which were elliptical in form, the longer axis pointing northeastward, the direction afterwards followed by this storm. This general form of this depression continued during its passage to the Saint Lawrence Valley, with slight changes in pressure, until the centre of disturbance reached the coast, when a decided decrease of pressure occurred, the barometer falling below 29.2 at Eastport, Maine, on the afternoon of the 24th. The telegraphic reports for the succeeding twenty-four hours from the northeastern stations are missing, but severe westerly gales continued in this section on the afternoon of the 25th, thus indicating that this depression passed over the Atlantic, attended by severe storms. The precipitation attending this area of low pressure was more marked in the south and east sections of the country, but light rains or snow were reported in all states and territories, except Dakota, during its passage over the country.

XII.—This area approached from the north Pacific and was observed north of Washington Territory on the afternoon of 23d. It crossed the continent in two days and sixteen hours, following approximately the path of the preceding storm, however, not passing as far to the south, on the eastern slope of the Rocky Mountains previous to the change of direction to the northeast, but it passed farther to the north while moving over the Lake region. After reaching the Saint Lawrence Valley it passed over New England to the south of Nova Scotia, following the course of the preceding storm, but exhibiting much less energy. During the movement of this area of low pressure to the eastward the barometer fell to 29.50 at stations near the centre in Nebraska, after which the pressure rose and again fell to 29.50 when the centre was passing over Lake Huron. From this point eastward to the Atlantic the pressure at the centre increased.

XIII.—This disturbance also passed from the north Pacific coast, where it was central on the 26th, and from the tri-daily weather charts it may be traced to the north of the upper lake region on the 29th. It was at no time central within the limits of the United States, but was attended by severe gales in the Lake region and general rains or snows over the central valleys, Lake region, and Atlantic States when the centre was near Lake Superior, from which region it apparently moved northeastward and did not reach the coast within the limits of observation.

XIV.—This storm apparently developed during the night of the 28th, over Montana. The depression was elongated and located between two high areas, one to the north of Montana and the other on the central Pacific coast, the longer axis pointing to the southeast. It moved rapidly to southern Minnesota during the succeeding eight hours, the general form continuing but the larger axis pointing to the northeast. This rapid movement to the eastward was apparently due to the union of the two high areas previously referred to. It passed eastward over the Lake region to the Saint Lawrence Valley during the 29th and 30th with increasing energy near the centre of disturbance, but without causing any decided change in the atmospheric conditions south of the Lake region and New England. The minimum barometric pressure (29.21) within this low area occurred at Anticosti, Gulf of Saint Lawrence, on the morning of the 31st. The barometric pressure within the central area decreased slowly during its movement eastward from the Rocky Mountains.

NORTH ATLANTIC STORMS DURING JANUARY, 1887.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the proprietors of the "New York Maritime Register," and from other miscellaneous data received at this office up to February 22, 1887.

Twelve depressions are traced, of which, seven passed northeastward over, or in the vicinity of, Newfoundland; four first appeared over mid-ocean, and one apparently developed off the east coast of the United States. The general course of direction of the depressions was east-northeast to northeast.

A severe storm prevailed over the British Isles during the 6th and 7th, with barometric pressure ranging below 29.00 (736.6) on the latter date. The disturbance occasioned strong gales between the fortieth and sixtieth parallels and east of the twenty-fifth meridian. This depression was probably a continuation of ocean depression number 2 which occupied the ocean northwest of Scotland on the 5th, after which date its course cannot be accurately determined, owing to an absence of reports.

The depression traced as number 1 first appeared off the southeast coast of Greenland on the 2d and passed east to the north of Scotland. Number 2 passed northeast over the southern portion of Newfoundland during the morning of the 3d and moved rapidly northeast to the north of Scotland by the 5th. Number 3 followed a course similar to that pursued by number 2 during the 7th, 8th, and 9th. Number 4 appeared over the ocean west of Ireland on the 10th and moved to the west coast of Scotland by the 11th. Number 5 passed over Newfoundland during the early morning of the 11th and moved rapidly north-

maximum velocity, thirty-two miles per hour from the northwest, at 10.20 p. m. Light rain fell from 6.30 to 7.10 p. m.

X.—Number x was observed in northern Montana on the morning of the 19th; it passed southeastward, following the general course of the preceding storm; the southeasterly movement ended in southern Dakota and the storm passed over the upper lake region on the 22d, developing considerable energy when central near Mackinaw City, Michigan, where the barometer fell to 29.01 on the afternoon of the 20th. It moved northeastward over the Saint Lawrence Valley, causing gales at extreme northeastern stations on the 21st. The central area became greatly extended as it moved to the northeast, but the wind increased in force and the most severe gales reported during the month occurred along the Atlantic coast as this storm passed over that region.

The following notes by Signal Service observers are of interest:

Buffalo, New York: a southwesterly gale set in at 7.30 a. m. of the 20th and continued until 6 a. m. of the 21st; at 9.10 a. m. it reached a velocity of fifty-eight miles per hour. During the storm the ice on the lake was broken up for a distance of about ten miles out, which is a very unusual occurrence for this season.

Mackinaw City, Michigan: a southerly gale, shifting to the southwest, began at 1.45 a. m. of the 20th; during the afternoon the wind shifted to the west, and attained a velocity of thirty-six miles per hour at 7.45 p. m. The barometer fell rapidly until 1.30 p. m. when it stood at 28.97, after 1.30 p. m. it began rising rapidly.

Cairo, Illinois: during the 20th high variable winds prevailed, maximum velocity forty-four miles per hour from the southwest. River men state that this was the strongest wind that has occurred on the river for many years; several barges were torn from their moorings and blown across the river.

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